REMARKS

Attorney for Applicants has carefully reviewed the outstanding Office Action on the above-identified application. Applicants have amended the application, and respectfully submit that the application, as amended herein, is in condition for allowance.

Attorney for Applicants would like to thank Examiner Jacques Saint Surin for the courtesies extended in a telephone interview conducted on July 21, 2004. As a result of the telephone interview, Applicants have amended each independent claim to highlight the **amplitude** modulation scheme of the present invention in order to clarify the claimed invention and thereby differentiate the claimed invention from the references of record. Applicants submit that the pending claims, as amended herein, are in condition for allowance.

Applicant's claimed invention, as amended herein, relates to a method and apparatus for remote measurement of vibration and properties of objects. The invention provides an electromagnetic wave vibrometer apparatus comprising a signal generator for generating an electromagnetic signal; a modulator for amplitude modulating the electromagnetic signal to produce an amplitude modulated signal; a transmitter for transmitting the amplitude modulated signal at a vibrating object; a receiver for receiving a reflected amplitude modulated signal from the vibrating object; a demodulator for demodulating the amplitude modulated signal; and a signal processor for analyzing a vibration waveform of the demodulated signal. (Claim 1).

Applicants' claimed invention, as amended herein, also provides an apparatus for remotely measuring properties of an object comprising a signal generator for generating an

electromagnetic signal; a modulator for amplitude modulating the electromagnetic signal to produce an amplitude modulated signal; a transmitter for transmitting the amplitude modulated signal at an object; means for vibrating the object to modulate the amplitude modulated signal transmitted at the object; a receiver for receiving a reflected amplitude modulated signal from the object; a demodulator for demodulating the amplitude modulated signal; and a signal processor for analyzing the vibration waveform of the demodulated signal. (Claim 11).

Further, Applicants' claimed invention, as amended herein, provides a method of remotely measuring vibration comprising the steps of generating an electromagnetic signal; modulating the electromagnetic signal to produce an amplitude modulated signal; transmitting the amplitude modulated signal at a vibrating object; receiving a reflected amplitude modulated signal from the vibrating object; demodulating the reflected amplitude modulated signal; and analyzing the demodulated signal. (Claim 21).

Moreover, Applicants' claimed invention provides a method for remotely determining properties of an object comprising the steps of modulating an electromagnetic signal to produce an amplitude modulated signal; transmitting the amplitude modulated signal at an object: vibrating the object; receiving reflected amplitude modulated signals from the vibrating object; and processing the amplitude modulated signals to extract information about the properties of the object. (Claim 32).

Claims 1-2, 7, 9-12, 17, 19-23, 27, 29-34, 38, and 41-43 were rejected as being anticipated by U.S. Patent No. 4,554,836 to Rudd. The remaining claims were rejected as being obvious over Rudd in various combinations with Kljuev, et al., Flock, et al., and Wang, et al.

Rudd discloses a laser vibrometer. A laser light source generates a laser beam that is modulated by an acousto-optic modulator, shifting the *frequency* of a portion of the laser beam. The modulated light beam passes to a vibrating object, which scatters the light. The reflected light is heterodyned with the unshifted portion of the laser beam in a photodiode to produce a phase modulated signal at the acoustic frequency of the modulator. Surface displacement is measured as a function of instantaneous phase shift, and surface velocity as a function of the rate of change of the phase shift.

Rudd fails to teach each element of Applicants' claimed invention as set forth in amended claim 1. Specifically, Rudd fails to teach or suggest an electromagnetic wave vibrometer apparatus comprising: a signal generator for generating an electromagnetic signal; a modulator for amplitude modulating the electromagnetic signal to produce an **amplitude modulated signal**; a transmitter for transmitting the **amplitude modulated signal** at a vibrating object; a receiver for **receiving a reflected amplitude modulated signal** from the vibrating object and extracting the envelope of the reflecting signal; a demodulator for **demodulating the amplitude modulated signal**; and a signal processor for analyzing a vibration waveform of the demodulated signal, as set forth in amended claim 1.

While Rudd teaches *frequency* modulating a laser signal prior to transmission of the signal to the vibrating object, Rudd fails to teach *amplitude* modulating the signal prior to transmission of the signal. Rudd is equally devoid of any disclosure relating to receiving an amplitude modulated signal from the vibrating object, and demodulating the amplitude modulated signal to extract vibration information. Rather, Rudd heterodynes two signals and measures phase differences of the signals (classic interferometry) to determine an object's vibration. Applicants' invention does not rely on classic interferometry, but rather, incorporates an entirely different scheme based upon amplitude modulation of a signal prior to transmission of the signal to an object, and analysis of a reflected amplitude modulated signal. Therefore, Applicants submit that claim 1, as amended, is patentable over Rudd.

The Office Action states that the Bragg cell disclosed in Rudd is inherently capable of amplitude modulating a signal. Applicants respectfully traverse this statement. No reference in support of this statement has been provided, and Rudd merely discloses using the Bragg cell to frequency modulate a signal. Assuming, *arguendo*, that Bragg cells do inherently amplitude modulate a signal, Rudd still fails to disclose each element of Applicants' claimed invention, as amended herein, as Rudd fails to disclose receiving a reflected amplitude modulated signal from a vibrating object, and demodulating the amplitude modulated signal to extract vibration information. Rather, Rudd analyzes phase differences between two signals to derive vibration information. As such, Applicants respectfully submit that claim 1, as amended, is patentable over Rudd.

Applicants respectfully submit that independent claims 11, 21, and 32, as amended herein, are also patentable over Rudd. Similar to amended independent claim 1, independent claims 11, 21, and 32 each recite the transmission of an amplitude modulated signal to a vibrating object, and the reception and demodulation of a reflected amplitude modulated signal to extract vibration information. For example, claim 11, as amended, recites an apparatus for remotely measuring properties of an object comprising a signal generator for generating an electromagnetic signal; a modulator for amplitude modulating the electromagnetic signal to produce an **amplitude modulated signal**; a transmitter for transmitting the **amplitude modulated signal** at an object; means for vibrating the object to modulate the amplitude modulated signal transmitted at the object; a receiver for **receiving a reflected amplitude modulated** signal from the object; a demodulator for **demodulating the amplitude modulated signal**; and a signal processor for analyzing the vibration waveform of the demodulated signal.

Likewise, claim 21 recites a method of remotely measuring vibration comprising the steps of generating an electromagnetic signal; modulating the electromagnetic signal to produce an **amplitude modulated signal**; transmitting the **amplitude modulated signal** at a vibrating object; receiving a **reflected amplitude modulated signal** from the vibrating object; **demodulating the reflected amplitude modulated signal**; and analyzing the demodulated signal. Moreover, claim 32 recites a method for remotely determining properties of an object comprising the steps of modulating an electromagnetic signal to produce an **amplitude modulated signal**; transmitting the **amplitude modulated signal** at an object; vibrating the object; **receiving reflected amplitude modulated signals** from the vibrating object; and **processing the amplitude modulated signals** to extract information about the properties of the

object. As such, Applicants submit that independent claims 11, 21, and 32, as amended herein, are patentable over Rudd.

Regarding the rejections of Applicants' remaining claims as being unpatentable over one or more of Rudd, Kljuev, et al., Flock, et al., or Wang, in view of Applicants' amendments to independent claims 1, 11, 21, and 32, Applicants submit that claims 2-10, 12-20, 22, 24-31, 33, and 35-43, which depend from amended claims 1, 11, 21, and 32 and contain all of the limitations thereof, are patentable over these references, taken alone or in combination.

Kljuev, et al. discloses a device for measuring vibrations including a microwave generator and an antenna for transmitting microwaves to an object to be investigated. Microwaves are phase modulated by the object and are reflected back to a detector, where they are mixed (heterodyned) with the unmodulated microwaves to produce a signal indicative of the object's vibration. Kljuev, et al. is devoid of any teaching suggestion, or motivation to amplitude modulate a signal, and receiving and demodulating a reflected amplitude modulated signal to extract vibration information.

Flock, et al. fails to remedy the deficiencies of Kljuev, et al. and Rudd. Flock, et al. discloses a vibrometer which detects the variation of the speckle interference pattern of reflected waves. Flock, et al. fails to teach or suggest generating an amplitude modulated signal, receiving a reflected amplitude modulated signal from a vibrating object, and demodulating the signal to extract vibration information.

Moreover, Wang, et al. fails to remedy the deficiencies of Flock, et al., Kljuev, et al., and Rudd. Wang, et al. discloses a laser vibrometer which includes a laser beam, a beam splitter, two reflectors, an optical processor having two optical sensors, a digitizer for converting an analog signal to a digital signal, a flip-flop circuit, and a counter. Wang, et al. is unconcerned with generating an amplitude modulated signal, receiving a reflected amplitude modulated signal from a vibrating object, and demodulating the signal to extract vibration information.

As such, Applicants respectfully submit that claims 2-10, 12-20, 22, 24-31, 33, and 35-43, which depend from amended independent claims 1, 11, 21, and 32, respectively, are patentable over the cited references, taken alone or in combination.

All issues raised in the Office Action are believed to be addressed. Claims 1, 11, 21, and 32 were amended. Claims 1-22, 24-33, and 35-47 are pending in this application, and are believed to be in condition for allowance. No new matter is believed to have been added. Re-examination is requested and favorable action solicited.

Respectfully submitted,

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